



## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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<b>(21) International Application Number:</b> PCT/GB92/00515 <b>(22) International Filing Date:</b> 20 March 1992 (20.03.92) <b>(30) Priority data:</b> 9105969.1                      21 March 1991 (21.03.91)                      GB <b>(71) Applicant (for all designated States except US):</b> DANSAM HOLDINGS LIMITED [GB/GB]; Mill Green House, Mill Green Road, Haywards Heath, West Sussex RH16 1XQ (GB). <b>(72) Inventor; and</b> <b>(75) Inventor/Applicant (for US only) :</b> HAFFENDEN, John, Keir [GB/GB]; 17 Wickham Way, Hawywards Heath, West Sussex RH16 1UG (GB). <b>(74) Agents:</b> CHEYNE, John, Robert, Mackenzie et al.; Haseltine Lake & Co., Hazlitt House, 28 Southampton Buildings, Chancery Lane, London WC2A 1AT (GB).		<b>(81) Designated States:</b> AT (European patent), AU, BE (European patent), CA, CH (European patent), DE (European patent), DK (European patent), ES (European patent), FR (European patent), GB (European patent), GR (European patent), IT (European patent), JP, LU (European patent), MC (European patent), NL (European patent), SE (European patent), US.  <b>Published</b> <i>With international search report.</i>
<b>(54) Title:</b> BAR-CODE READER  <div style="text-align: center;"> </div>		
<b>(57) Abstract</b>  <p>This invention relates to a bar-code reader for transferring an optical image to an optoelectronic processing unit, for applications such as the reading of bar-codes on goods for sale in supermarkets. The bar-code reader comprises a light inlet (11) and an image detector, light being conveyed from the light inlet (11) to the image detector by means of a light pipe (1), which may comprise any suitably shaped solid body made of a transparent material. The light pipe (1) may be angled at at least one corner and have matt outer surfaces except at the or each corner where the outer surface is polished and at regions where the light is to be transmitted into or out of the light pipe (1). This arrangement allows the bar-code image to be conveyed from the light inlet (11) to the image detector along a bent path without significant loss of intensity of the bar-code image. Preferably the light pipe (1) is formed as a light trap to illuminate multi-paths from the inlet (11) to the image detector. Typically this may be achieved by forming notches, angles or serrations (7) in the side of the light pipe (1).</p>		

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**BAR-CODE READER**

This invention relates to a bar-code reader for transferring an optical image to an optoelectronic processing unit, for applications such as the reading  
5 of bar-codes on goods for sale in supermarkets.

The use of bar-code readers has increased substantially in recent years in retail outlets such as supermarkets. Use of the bar-code on a product is an easy method of conveying the product identity, and a  
10 bar-code reader in combination with a database can significantly help to improve stock control and checkout times. Furthermore, a bar-code reader, adapted for customer use, may be employed in a check-out installation such as is described in British Patent  
15 Application No. 9013042.8 (Serial No. ). In such a system, a bar code reader is associated with each customer trolley or basket, and customers use the bar-code readers to identify goods which they select. The bar-code readers include memories for storing data  
20 relating to the goods for sale in the supermarket, and processing devices for calculating, inter alia, the total price and total weight of goods selected by a customer.

Current bar-code readers are either fixed  
25 installations, where the goods are passed over the bar-code reader, or incorporated within hand-held units which are placed near to each bar-code to read it. The optical image is then passed to a detection device, typically a charge-coupled device.

30 These bar-code readers have the disadvantage that the light path from the input to the detection device cannot be bent without the use of mirrors. In many situations it may be desirable to bend the path of light for example to enable a more compact arrangement.  
35 The use of mirrors to achieve the required bent light path reduces the ability of the bar-code reader to

withstand shocks such as those sustained when dropped or knocked.

The performance of the bar-code reader is directly related to the quality of the optical image that is  
5 received by the detection device. The bar-code reader must therefore maximise the amount of reflected light received from the bar-code and minimise interference from other sources.

Thus the present invention seeks to provide a bar-  
10 code reader which at least alleviates the disadvantages of the known devices.

According to the present invention there is provided a bar-code reader having a light inlet and an image detector, further including a light pipe for  
15 conveying light from the light inlet to the image detector.

The light pipe may be any suitably shaped solid body made of a transparent material.

This provides the advantage that the light path  
20 from the light inlet to the image detector may be bent, while the reader is mechanically robust.

The present invention also provides a bar-code reader wherein the light pipe is angled at at least one corner and wherein the light pipe has matt outer  
25 surfaces except at the or each corner where the outer surface is polished and at regions where light is to be transmitted into or out of the light pipe.

This arrangement allows the bar-code image to be conveyed from the light inlet to the image detector  
30 along a bent path without significant loss of intensity of the bar-code image, as reflection occurs at polished surfaces, whilst light from other sources entering the light pipe will be severely attenuated by reflection at the matt surfaces.

35 Preferably the light pipe is formed as a light trap to eliminate multipaths from the inlet to the

image detector.

Typically this may be achieved by forming notches, angles or serrations in the side of the light pipe.

This arrangement has the advantage that the bar-code image is not affected, but the multipath images, i.e. images which would be formed at the image detector following multiple reflections of the incoming light off the internal surfaces of the light pipe, which degrade the bar-code image are trapped and prevented from reaching the image detector.

In one preferred embodiment the bar-code reader further includes a light source, the light pipe having a thickened portion between the light source and the light inlet, and the light source being positioned to supply light through the thickened portion of the light pipe and out through the light inlet to illuminate a bar-code positioned adjacent the light inlet.

This arrangement provides local illumination of the bar-code which ensures that the reflected image is easily read.

The bar-code reader may be adapted for hand held operation. This enables the bar-code reader to be used to read bar-codes on heavy or awkward items and also to provide an ability to read codes at a distance from the base unit. Furthermore, the bar-code reader may be adapted for customer use, in an installation as described in British Patent Application No. 9013042.8 (Serial No. ).

For a better understanding of the present invention, and to show more clearly how it may be brought into effect, reference will now be made, by way of example, to the accompanying drawings, in which:-

Figures 1a and 1b show, schematically, the construction of a light pipe for use in a bar-code reader according to this invention;

Figure 2 illustrates the arrangement of a light

pipe in a bar-code reader according to one embodiment of the present invention; and

Figure 3 shows an alternative embodiment of bar-code reader having a separate light emitting pipe.

5 In a bar-code reader in accordance with the present invention, the light pipe provides a path for the light reflected by a bar-code to an optoelectronic detector and processor. The reader must also provide local illumination of the bar-code while minimising  
10 external light and light from multipaths entering the detection process.

The light pipe 1 for use in a bar-code reader according to an embodiment of the present invention is shown in Figures 1a and 1b. The light pipe 1 guides  
15 light from a light inlet 11 to an outlet 12. The light pipe is a clear plastics moulding, typically made of perspex or polyacrylate, which has been shaped and selectively polished so that the light entering may be guided without the use of mirrors to the outlet. At  
20 the light inlet 11 and outlet 12, the surface of the light pipe is polished. LEDs 2 are used to illuminate the bar-code and are positioned behind the illumination inlet 3 at the head of the light pipe. The illumination inlet 3 is a polished surface of the light  
25 pipe, and the LEDs 2 are angled so that light from them is directed to a common reading point in front of the light pipe where the bar-code is to be positioned. The LEDs 2 are positioned so that as much light as possible is reflected into the light pipe from the bar-code.

30 The bar-code image thus enters the light pipe 1. As is illustrated most clearly in Figure 1b the light pipe may be bent and the surface 5 of the light pipe is polished at the or each corner to effect bending of the light path round the corner using internal reflection  
35 at the plastics/air interface. All other surfaces 6 of the pipe, apart from the inlets 3, 11 and the outlet 12,

are matt.

Located at the outlet 12 of the light pipe is a lens 13 which provides an image to a CCD image detector.

5 In order that the optoelectronics is able to decode the bar-code accurately, the light received at the lens 13 from the light pipe must be predominantly the reflected bar-code image and therefore other light sources must be eliminated or their intensity reduced.

10 The light passing through the light pipe comes from three main sources. The first is the image directly reflected from the bar-code which passes down the light pipe to the lens 13 by reflection at the polished surfaces. However, light is also reflected  
15 from the bar-code in all directions and some of this light enters the light pipe and will pass down the light pipe to the lens by internal reflection at the light pipe walls. In addition a small amount of  
20 external light will enter the light pipe through the external polished surface.

The interference from these light sources is minimised by the matt surfaces 6 of the light pipe because a considerable proportion of the light is lost during reflections at matt surfaces. In addition  
25 multipath interference which causes "flare" is further eliminated by notches or serrations 7 cut in the sides of the light pipe which reflect light away from the lens.

Figure 2 shows the light pipe of Figure 1  
30 incorporated into a hand-held bar-code reader.

The reader has a top casing 8 and a bottom casing 9 shaped to permit easy and efficient use of the bar-code reader. The use of the light pipe 1 enables the light path to be bent and hence allows the casing to be  
35 designed for maximum ease of use.

The illumination of the bar-code is provided by a

local bank of high brightness LEDs 2. The LEDs are spaced across the front of the reader, but are angled to ensure that the reflected beam is directed towards the optical centre of the lens 13.

5       The reflected bar-code image is captured by the light pipe 1 which passes it to the lens 13 and a light box 4 containing a CCD 14, by means of internal reflection at the polished surface 5.

10       The CCD is a linear array of photodiodes which detects the incoming image and converts it to an electronic signal. The output of the CCD is amplified and then applied to a threshold amplifier which converts the analogue signal from the CCD to a digital signal for interfacing with the processor.

15       Otherwise, the general form of the reader is conventional, and it includes a battery compartment 15, a switch 16, and a display 17. The reader also contains any memory or processing capability required for its operation in the particular system being used.

20       Thus, a bar-code reader according to this invention provides improved performance both optically and mechanically.

Figure 3 shows an alternative embodiment of bar-code reader, in which the LEDs 2 which are used to  
25       illuminate the bar-code are set back from the light inlet 11. A light emitting pipe 20 directs the light from the LEDs 2 to the light inlet 11. As is clear from Figure 3, the position of the light emitting pipe 20 or the light pipe 1 may be varied within the body of  
30       the bar-code reader. The principle of operation would remain the same, since the light is contained within the light emitting pipe 20 and the light pipe 1 therefore guaranteeing stability of omission and collection in relation to the light source (e.g. the  
35       LEDs 2), the front opening of the reader (e.g. the light inlet 11) and the lens 13. The light emitting

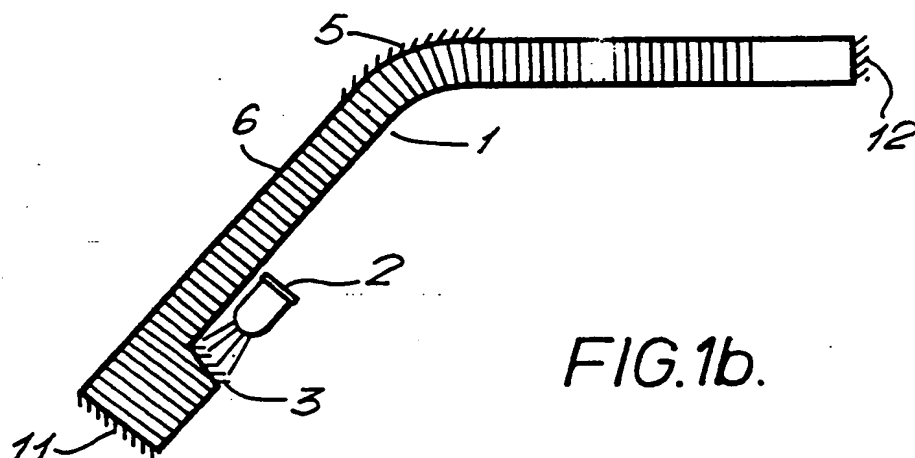
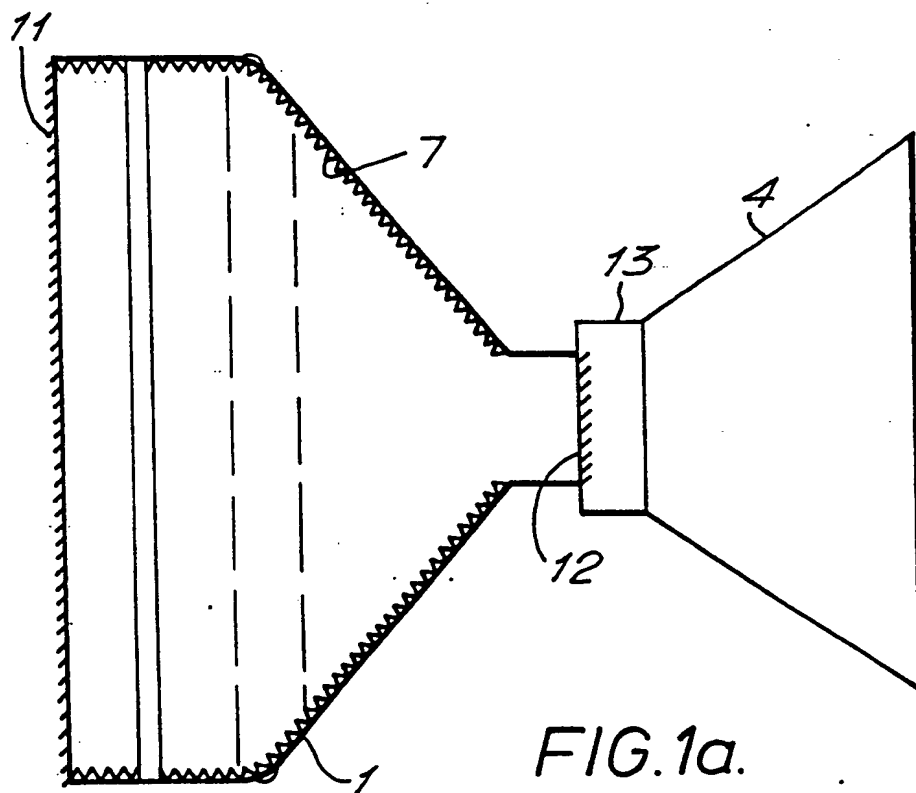


pipe 20 may be constructed in a similar manner to the light pipe 1.

CLAIMS

1. A bar-code reader having a light inlet and an image detector, further including a light pipe for conveying light from the light inlet to the image  
5 detector.
2. A bar-code reader as claimed in claim 1, wherein the light pipe is made of plastics.
3. A bar-code reader as claimed in claim 1 or 2, wherein the light pipe is angled at at least one corner  
10 and wherein the light pipe has a polished outer surface at the or each corner.
4. A bar-code reader according to one of claims 1 to 3 characterised in that the light pipe is formed as a light trap to eliminate multipaths from the inlet  
15 to the image detector.
5. A bar-code reader as claimed in claim 4, wherein the light pipe has notches, angles or serrations formed in side surfaces thereof.
6. A bar-code reader as claimed in any preceding  
20 claim, further including a light source, the light pipe having a thickened portion between the light source and the light inlet, and the light source being positioned to supply light through the thickened portion of the light pipe and through the light inlet to illuminate a  
25 bar-code positioned adjacent the light inlet.
7. A bar-code reader as claimed in any preceding claim, adapted for hand-held use, and including a power source.
8. A bar-code reader as claimed in one of claims  
30 1 to 6, adapted for hand-held use, and including a flexible connection to a base unit.
9. A bar-code reader, substantially as herein described with reference to the accompanying drawings.

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SUBSTITUTE SHEET

2/2

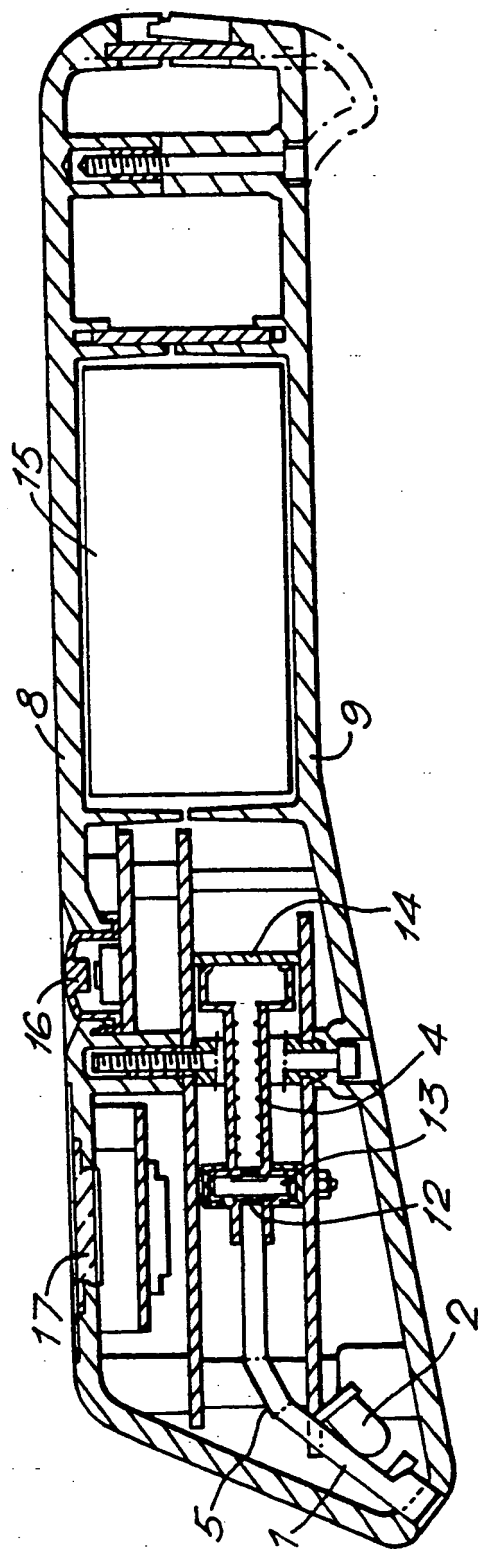


FIG. 2.

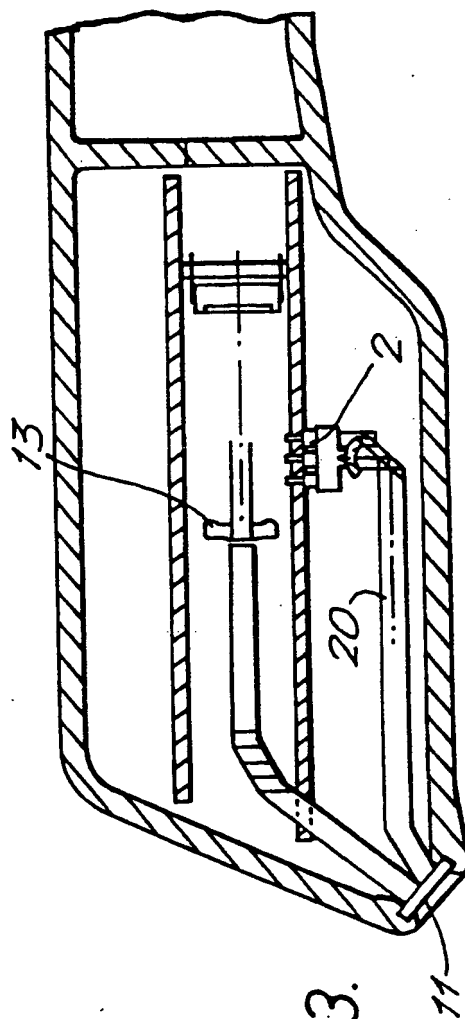


FIG. 3.

## INTERNATIONAL SEARCH REPORT

PCT/GB 92/00515

International Application No

<b>I. CLASSIFICATION OF SUBJECT MATTER</b> (If several classification symbols apply, indicate all) <sup>6</sup>		
According to International Patent Classification (IPC) or to both National Classification and IPC		
Int.Cl. 5 G06K7/10		
<b>II. FIELDS SEARCHED</b>		
Minimum Documentation Searched <sup>7</sup>		
Classification System	Classification Symbols	
Int.Cl. 5	G06K	
Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched <sup>8</sup>		
<b>III. DOCUMENTS CONSIDERED TO BE RELEVANT<sup>9</sup></b>		
Category <sup>10</sup>	Citation of Document, <sup>11</sup> with indication, where appropriate, of the relevant passages <sup>12</sup>	Relevant to Claim No. <sup>13</sup>
X A	GB,A,2 163 584 (P. FULLER) 26 February 1986 see abstract; figure 1 see page 1, line 97 - line 105 see page 2, line 2 - line 22 ---	1,7,8 3,6
X Y A	FR,A,2 161 924 (THE MARCONI COMPANY LIMITED) 13 July 1973 see page 2, line 36 - line 39 see page 3, line 14 - line 19 see page 3, line 34 - line 38 see figure 1 ---	1,2 7 4-6,8
Y	EP,A,0 094 571 (MSI DATA CORPORATION) 23 November 1983 see abstract; claim 1 ---	7
X A	DE,A,3 423 131 (TS-OPTOELECTRONIC) 16 January 1986 see abstract; claim 1; figure 2 ---	1 3,7,8
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<p><sup>10</sup> Special categories of cited documents:</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art</p> <p>"A" document member of the same patent family</p>		
<b>IV. CERTIFICATION</b>		
Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report	
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III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)		Relevant to Claim No.
Category *	Citation of Document, with indication, where appropriate, of the relevant passages	
A	WO,A,8 605 280 (TELEFONAKTIEBOLAGET) 12 September 1986 see abstract; figures 2,3 ---	1,2,6,7
A	EP,A,0 071 304 (PHILIPS) 9 February 1983 see abstract; claims 1,2 ---	1,4-8
A	IBM TECHNICAL DISCLOSURE BULLETIN vol. 25, no. 5, October 1982, NEW YORK pages 2362 - 2363; W.M. ROUTT: 'REFLECTIVE OBJECT SENSOR' see the whole document ---	6

# ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO.

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